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(54) SPRAY DRYING PROCESS FOR TEA POWDER

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SPRAY DRYING PROCESS FOR TEA POWDER

ABSTRACT OF THE DISCLOSURE

A spray drying process is described for producing an improved free-flowing, turbidity-free, tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water. The process involves the incubation of a tea extract with an appropriate enzyme preparation either before or after the tea extract has been subjected to a cold water solubilization operation. The extract is then concentrated in an evaporator or similar device and the tea extract is then spray dried at a solids concentrations of above about 51%. When compared to conventional spray dried tea powders, the tea powder produced by the present process has a more rapid rate of dispersibility and dissolution upon reconstitution in cold water.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for preparing a free-flowing turbidity-free tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water, comprising a combination of steps of

(a) incubating a tea extract with an appropriate amount of pectinase and processing the extract until a cold water soluble tea concentrate of above 51% solids concentration is obtained, and

(b) spray drying the highly concentrated tea extract under conventional spray drying conditions.

2. A process as defined in Claim 1, wherein the tea extract is incubated with approximately 0.50-1.0% of pectinase to the weight of tea solids and then processing the same into a cold water soluble tea concentrate of above about 51% solids concentrate.

3. A process as defined in Claim 1, wherein the temperature of the incubation step ranges from about 20°C to 65°C.

4. A process as defined in Claim 2, wherein the temperature during the incubation period is about 50°C.

5. A process as defined in Claim 4 wherein the incubation period is for approximately 30 minutes to one hour.

6. A process as defined in Claim 5, wherein a predetermined amount of malto-dextrin is added to the tea concentrate and the concentrate adjusted to a tea solids concentration of about 60.8% prior to the spray drying step.

7. A process as defined in Claim 1, wherein the tea extract is incubated with pectinase during a continuous filling of a tea extract storage tank and wherein the average incubation time is approximately 30 minutes.

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8. A process for preparing a free-flowing turbidity-free tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water, comprising a combination of steps of

(a) incubating a tea extract of about six (6)% solids concentration for approximately 30 minutes with 0.50 to 1.00% of pectinase to the weight of tea solids at a temperature range of 20°C. to 65°C. and processing the extract until a cold water soluble tea concentrate of about 51% solids concentration is obtained, and

(b) spray drying the highly concentrated tea extract under conventional spray drying conditions.

9. As an improved article of manufacture, the tea powder obtained by the process of Claim 1, wherein the resulting tea powder is free-flowing, turbidity-free and having a rapid rate of dispersibility and dissolution upon reconstitution in cold water of about 7°C.

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FIELD OF INVENTION

This invention relates to a novel process for improving the rate of dispersibility and dissolution of a freeflowing, turbidity-free spray dried tea powder upon reconstitution in cold water. More specifically, the invention relates to a process for treating tea extracts by a combination of unique steps including the steps of incubating a tea extract with an appropriate enzyme preparation, preferably one having pectinase activity, either before or after the tea extract has been subjected to a cold water solubilization operation, thereafter concentrating the tea extract and spray drying the tea extract at solids concentration of above about 51%, under conventional spray drying conditions. The tea powders of excellent quality, color, clarity and palatability that are obtained by this process are especially characterized by their rapid rate of dispersibility and dissolution upon reconstitution in cold water.

DESCRIPTION OF PRIOR ART

There are presently available a wide variety of spray drying processes for producing tea powders. However, these spray drying processes have not been found acceptable as producing a tea powder having a rapid rate of dispersibility and dissolution upon reconstitution in cold water. In view of our findings in the present invention, we believe that these unsatisfactory results are primarily due to the low concentration of tea extracts that are normally required during spray drying operations to handle the extracts, coupled with the unsatisfactory rheological properties of the tea extracts.

Black tea is generally made from green tea leaves by subjecting the tea leaves to a series of processing

conditions including (1) withering, (2) rolling or otherwise disintegrating, (3) fermenting and (4) firing. Rolling or other disintegration initiates the enzymic reactions of fermentation during which the characteristic color, flavour and aroma of black tea are developed. When the fermentation has progressed sufficiently, the tea leaves are fired (i.e., dried). This arrests the enzymic reactions and the resulting product possesses the characteristic appearance of black tea. (See, for example, Millin, D. J. & Rustidge, D.W. (1967) Process Biochemistry 2 no. 6 page 9).

Black tea extracts or infusions, as is well known in the art, are normally produced by a hot water countercurrent extraction process. Such processes are described, for example, in United States Patent Nos. 2,902,368; 2,912,334; 3,065,077; and 3,080,237 as well as other literature.

Green tea includes freshly gathered tea leaves, tea leaves that have been freshly gathered and dried immediately, tea leaves that have been heat treated before drying and aqueous extracts of these leaves. In each instance, the green tea has undergone substantially no fermentation to the black state.

The green tea or green tea extracts may also be converted to simulated black tea extracts, by chemical or enzymatic means, as described in United States Patent Nos. 3,484,246 and 3,649,297.

Tea extracts, and particularly dried black tea extracts or simulated black tea extracts, when made to beverage concentration in water, generally become turbid, if the beverage or extract is allowed to cool, for example to room temperature or lower. The turbidity is caused by precipitated tea material which in the trade is normally

referred to as "cream". This turbidity is highly objectionable to consumers of cold tea beverages.

In order to produce a turbidity-free, water-soluble instant tea or tea extract, and particularly one that is soluble in cold water, it is generally necessary to separate some or all of the cream from the extract. This is usually accomplished by cooling the extract, causing the cream to precipitate. The cream is then removed, for example, by centrifuging.

The amount of cream removed by centrifuging varies with the leaf tea used in the extraction, the viscosity and concentration of the tea extract, the temperature of the extract, and the gravitational force supplied by the centrifuge. The amount of cream removed, for example, at 7° C may be in the range between 20 and 35% of the extracted tea solids if the extract is at 5 to 10% solids concentration and as low as 4 to 8% if the extract is at lower concentrations (for example, 0.5 to 1% solids concentration). It is known that the removal of cold water insolubles from tea extracts by centrifuging can be made more efficient if the extract is first treated with pectinase enzymes, probably because this reduces viscosity of the tea extracts. (See United States Patent No. 3,163,539 and Indian Patent No. 117,003).

If desired, the removed cream may be chemically solubilized such as by means of oxidation at elevated pH and temperature. Suitable oxidants include oxygen and hydrogen peroxide. pH is elevated using a basic material such as, for example, sodium hydroxide or potassium hydroxide. After oxidation, pH may be lowered using edible acids such as phosphoric or acetic acid. The supernatant fraction and the solubilized cream fraction may then be recombined,

concentrated, and dried. Alternatively, all or a portion of the cream may be discarded. The drying may be accomplished by conventional processes, for example, by spray drying, vacuum drying or freeze drying.

The spray drying process has been commercially popular because of the economical advantages of the process. However, it has been found that cold water soluble tea powders produced by spray drying are generally dissolved in water at a temperature of 7° C and as low as 0°C. Frequently the powder forms unsightly clumps in the water, and dissolution may take many minutes. The problem increases with decreasing temperature of the water, and this has been an obstacle to consumer acceptance of tea powders produced by known spray drying processes. It is therefore highly important that an improved spray drying process be discovered which will produce a tea powder having a rapid rate of dispersibility and dissolution upon reconstitution in cold water.

In the case of tea powders produced by vacuum drying or freeze drying, the problem of clumping and slow dissolution is very slight compared with spray dried powder. However, these drying processes have not been found satisfactory due to the significant economical disadvantages associated therewith. These include the expensive equipment necessary to carry out vacuum drying or freeze drying, the maintenance thereof, low productivity rates due to the slow rate of removal of water from the tea extract and the relatively large amount of energy required to carry out vacuum drying or freeze drying.

Insofar as improving the tea powders produced by spray drying, it has been proposed to eliminate the problem of

clumping and slow dissolution in cold water by agglomerating the tea powders. Agglomeration prevents the clumping and increases the rate of dispersibility and dissolution upon reconstitution in cold water, but this additional operation is an expensive process. It has also been proposed to add surface active agents of food grade to the tea powder, but no improvement has been noted in these instances. It has also been thought that by varying the conditions of spray drying, the problem of clumping and slow dissolution of tea powders in cold water would be avoided. However, these proposed modifications to the spray drying process have also not solved the problem of clumping and slow dissolution. Accordingly, there has arisen a need in the industry for an improved spray drying process which will produce a free-flowing, turbidity-free tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water.

OBJECTS OF THE INVENTION

It is an object of the present invention to produce an improved free-flowing, turbidity-free, tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water. It is a further object of the present invention to provide an improved spray drying process for producing a free-flowing, turbidity-free, tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water. It is yet another object of the present invention to produce a spray dried tea powder having a rapid rate of dispersibility and dissolution in cold water of about 7°C and lower. Another object of the present invention is to provide a tea powder having a rapid rate of dispersibility and dissolution upon reconstitution in cold water and without a substantial destruction or loss of

desirable volatiles in the tea product. It is yet a further object of the present invention to provide a process for drying a tea powder with rapidity and economy and wherein the desired bulk density of the tea powder may be easily maintained and controlled during the drying process. Further objects of the present invention will become apparent upon the understanding of the following description of selected embodiments of this invention and upon a study of the appended claims.

Thus, in accordance with the present teachings, a process is provided for preparing a free-flowing, turbidity-free tea powder which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water. A tea extract is incubated with an appropriate amount of pectinase and the extract processed until a cold water soluble tea concentrate of above 51% solids concentration is obtained. The highly concentrated tea extract is then spray dried under conventional spray drying conditions.

In accordance with a further teaching of the present invention an improved tea powder produced by the process is obtained wherein the resulting tea powder is a free-flowing, turbidity-free material which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water of about 7°C.

DETAILED DESCRIPTION OF THE INVENTION

According to the process of the present invention, a tea extract may be prepared by any known extraction process. The tea extract is then incubated with an appropriate enzyme preparation at temperatures ranging from about 20°C to 65°C, but preferably at 50°C. The incubation period may be approximately 30 minutes to one hour or more, depending upon

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the enzyme concentration and temperature at which the reaction takes place.

It is believed that while the rheological modification of the tea extract may be measured by the reduction in viscosity of the tea extract, the desired modification is not necessarily a simple matter of reducing the viscosity of the tea extract. Instead, there are other modifications that bear consideration, such as the film forming characteristics of the tea extract, which in turn affect the character of the dried beads of tea powder as they are formed in the spray dryer. More specifically, it is believed that the rheological modification is presumably related to partial or complete hydrolysis of the tea pectins, which are likely to substantially control the rheological properties of the tea extract. Notwithstanding these beliefs, we have found that merely changing the rheological properties or concentration of the tea extract will not produce the desired improvement in cold water dispersibility and rate of dissolution. Instead, this change of rheological properties must be coupled with the spray drying of the tea extract at high tea solids concentrations.

The amount of the enzyme preparation such as pectinase to be added to the tea extract will vary according to the source of the preparation. The suitability of the preparation to be used will be measured by its ability to reduce the viscosity of the tea extract to a desired or maximum degree at the least expensive cost in a reasonable time period. For example, a preparation made from Aspergillus niger (Miles Spark-L)* is used at a level of about 1.5-1.0% by weight of tea solids, and the cost of the enzyme is only approximately 0.5 to 1¢ per pound of treated tea solids. Moreover, there

*Trademark

are other enzyme preparations such as Rohm and Haas Pectinol* 59L and Ciba Geigy Irgazyme* 100 which have similar economics and thus, have also proved satisfactory.

After the tea extract has been incubated with an enzyme preparation such as pectinase, the extract may then be subjected to a cold water solubilization operation. The tea extract is then concentrated by known means such as in an evaporator or similar device and a final tea solids concentrate of above about 51% is obtained. Once the tea extract is processed into a cold water soluble tea concentrate of above about 51% the extract is dried by conventional spray drying methods. By virtue of the unique combination of steps in the present invention, it is possible to spray dry a highly concentrated tea extract and control and maintain the desired bulk density of the tea powder resulting therefrom during the spray drying operation. This will permit a free-flowing, turbidity-free, tea powder to be produced by spray drying and which has a rapid rate of dispersibility and dissolution upon reconstitution in cold water.

In order to more precisely describe the nature of the present invention, the following specific examples will hereinafter be described. It should be understood, however, that the following descriptions are given solely by way of example, and are intended neither to delineate the scope of the invention nor limit the ambit of the appended claims.

Example 1

A commercially produced first tea extract of about six (6)% solids concentration was incubated for approximately thirty (30) minutes with 0.75% (w/w tea solids) of enzyme preparation of pectinase at temperature of 51.5°C. The first tea extract was then processed into a cold-water soluble tea

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concentrate of approximately 54.5% solids concentration.

A second tea extract produced in the same manner, except that it was not treated with an enzyme preparation such as pectinase was also adjusted to a solids concentration of 54.5%.

A third tea extract which also was not treated with pectinase was prepared and adjusted to a tea concentrate of 37% solids concentration.

The three tea extracts were then commercially spray dried and three batches of tea powder with equal bulk densities were obtained.

When the tea powder produced from the first extract, which was treated with pectinase, was reconstituted in cold water of about 7°C, the rate of dispersibility and dissolution of the tea powder was excellent and substantially faster than the poor rate of dispersibility and dissolution of the tea powders from the second and third extracts which were not treated with pectinase.

Example 2

A commercially produced first tea extract of about six (6) % solids concentration was incubated for approximately 30 minutes with 0.75 (w/w tea solids) of enzyme preparation of pectinase at temperature of 53°C. The first tea extract was then processed into a cold-water soluble tea concentrate of approximately 51% solids concentration.

A second cold-water soluble tea concentrate of approximately 51% solids was produced in the same manner, except that it was not treated with an enzyme preparation of pectinase.

These two tea concentrates were then commercially spray dried and two batches of tea powder with equal bulk densities were obtained.

When the two tea powders were reconstituted in cold water of about 7°C, the tea powder from the pectinase treated extract dispersed and dissolved much faster than the tea powder from the untreated extract.

Example 3

A commercially produced first tea extract of about six (6) % solids concentration was incubated for approximately 30 minutes with 0.92% (w/w tea solids) of enzyme preparation of pectinase at temperature of 54°C. The first tea extract was then processed into a cold-water soluble tea concentrate of approximately 52.9% solids concentration. Malto-dextrin equal to the amount of tea solids was then added to the tea concentrate and the concentrate was adjusted to a solids concentration of 60.8%.

A second cold-water soluble tea concentrate of about 49.0% solids was produced in the same manner, except that the enzyme preparation step of pectinase was omitted.

These two tea concentrates were then commercially spray dried and two batches of tea powders of equal bulk densities were obtained.

When the two tea powders were reconstituted in cold water of about 7°C, the tea powder from the pectinase treated extract dispersed and dissolved substantially faster than the tea powder processed from the untreated extract.

Example 4

During a continuous filling of a tea extract storage tank, a pectinase preparation was added continuously at a rate of 0.77% of the tea solids content to a first tea extract flow of about six (6) % solids concentration at temperature of about 54°C. The average incubation period of the first tea extract was 30 minutes. The tea extract was

then processed into a cold-water soluble tea concentrate of approximately 51.0% solids concentration.

A second tea extract flow of 51.0% solids was produced in the same manner, except for the pectinase treatment step.

These two tea extracts were subsequently spray dried by conventional means and two batches of tea powders of equal bulk densities were obtained.

When the two tea powders were reconstituted in cold water of about 7°C, the tea powder from the pectinase treated extract dispersed and dissolved at a substantially faster rate than that of the untreated tea extract.

It is apparent from the foregoing examples that a novel spray drying process is provided for preparing a free-flowing, turbidity-free tea powder. These tea powders have important advantages over conventionally spray dried powders, including improved flavour retention and faster dispersibility and dissolution upon reconstitution in cold water and yield a tea beverage resembling fresh iced tea beverages in flavour and appearance.

It should be manifest that while preferred embodiments of the present invention have been shown in Examples 1-4, the present invention is nevertheless capable of wide variation within the purview of the invention. For example, we have discovered that there are other means of modifying the rheological properties of the tea extracts. These other means include the use of prolonged heating, addition of calcium salts, and non-fat milk solids, pectins or similar means that will diminish or increase the interaction of the tea pectins and other tea materials and produce a change in the structure of the tea extracts. Also, we have found that other enzyme preparations such as those having proteolytic activity are capable of significantly changing the rheological

properties of tea extracts. Furthermore, while the preferred embodiment adds the enzyme preparation step prior to the cold water solubilization operation, such enzyme preparation operation may instead be added to the tea extract after the cold water solubilization operation. However, this will result in a tea powder, which upon reconstitution in cold water, has increased turbidity which is an undesirable characteristic to consumers.

It is believed that the present invention, its modus operandi, and many of the advantages attendant thereto should be readily understood from the foregoing without further description. It also should be manifest that while preferred embodiments and examples have been shown and described for illustrative purposes, the present invention is nevertheless capable of broad variation within the purview of the invention as defined in the appended claims.